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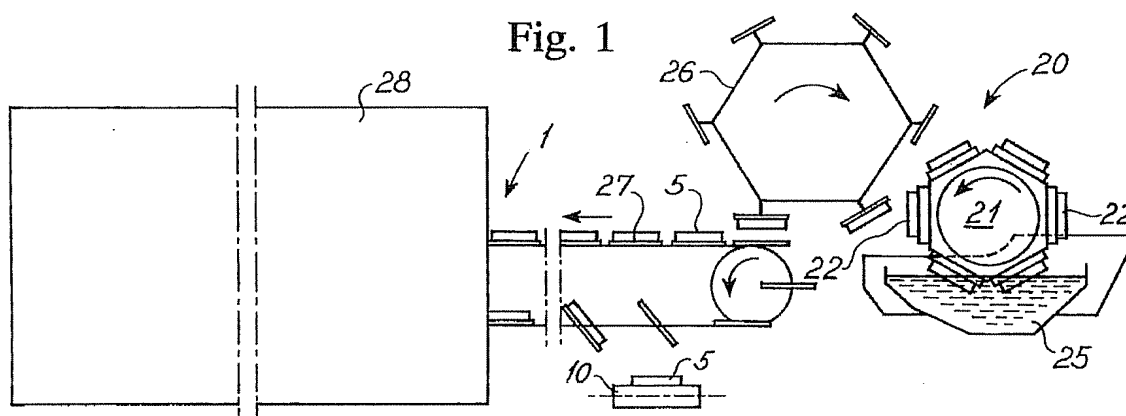
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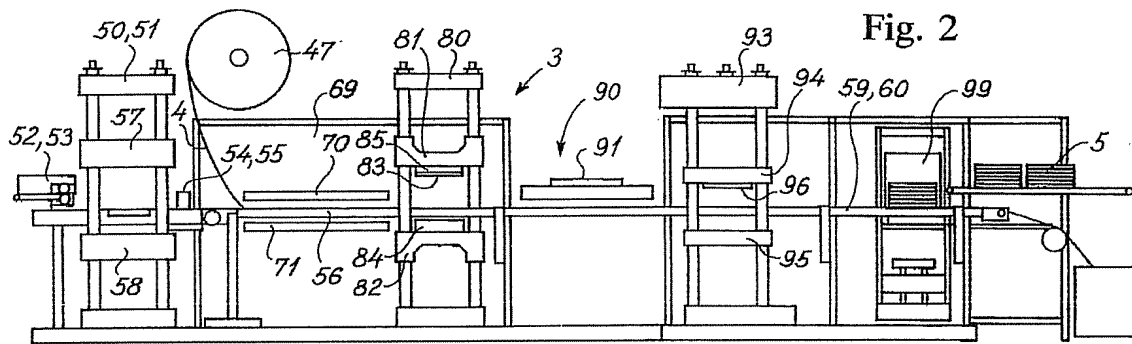
(54) **Method and apparatus for producing moulded pulp articles with a plastic film laminated thereon**

(57) The invention relates to an apparatus and method for producing articles 5 from moulded pulp material that are laminated with a plastic film 4. Thus an environmental friendly and water-resistant package for food products and for other moulded pulp products such as packages for industrial products is provided. The apparatus comprises a moulding line 1 and a laminating line 3. The moulding line 1 comprises a suction moulding station 20 with a pulp vat 25 and a number of suction

moulds 22, a drying oven 28 and conveying means 26, 28 for transporting the moulded pulp articles through the moulding line 1. The articles are transported in line by a conveyor 10 from the moulding line 1 to the laminating line 3, the laminating line 3 comprises a plastic film supply unit 47, a heating station 69 a laminating station 80 and conveying means 56 for conveying the articles 5 through the laminating line 3.

(It is suggested that Figure 1 be published with the Abstract).





## Description

### TECHNICAL FIELD

[0001] The present invention relates to an apparatus for producing moulded pulp articles that have a plastic film laminated thereon of the kind set forth in the preamble of claim 1. The invention also relates to a method of producing moulded pulp articles with a plastic film laminated thereon of the kind set forth in the preamble of claim 16.

### BACKGROUND ART

[0002] Moulded pulp articles are a desirable form of packaging since it is an environmental friendly non-expensive alternative to plastic and other materials for three dimensionally contoured packages. The use of such moulded pulp articles as food trays and the like has been desired since several decades. Moulded pulp is however not resistant to moist and as such thus not suitable for holding moist food or beverages. Therefore, several techniques have been developed for coating or laminating the moulded pulp packages with a moist resistant and preferably to provide them with a gas barrier. Other types of moulded pulp articles are packages for industrial products such as mobile phones or print cartridges. Dust and scratching from the pulp material can be problematic for certain sensitive industrial products. There exists therefore also a need for a technique to coat or laminate the moulded pulp articles from this perspective. None of the known techniques for this purpose have been able to meet the requirements for a successful commercial application.

[0003] EP-A-0-196 799 discloses an apparatus for laminating plastic film onto moulded pulp articles. Pre-formed articles are taken from a stack of articles by a destacking apparatus and placed in rows across a conveyor. The articles are fed by the conveyor and lined with a superimposed plastic film at a laminating station where the plastic film is bonded to the interior of the articles. This apparatus for the laminating of films to moulded pulp articles does not operate at desirably high speeds that allow successful commercial application. Further, the off-line mode of operation of the known prior art laminating line creates problems with handling and storing large amounts of articles between the production of the articles and the laminating line.

### DISCLOSURE OF THE INVENTION

[0004] On this background, it is the object of the present invention to provide an apparatus for producing moulded pulp articles of the kind referred to initially that operates at high rates. It is another object of the present invention to provide a method for producing moulded pulp articles that are laminated laminating a plastic film onto moulded pulp articles of the kind referred to initially

that allows operation at high rates. These objects are achieved in accordance with claim 1 and 16 respectively by transporting the moulded pulp articles in line from the moulding section to the laminating section.

[0005] According to an embodiment of the invention, the moulding line is adapted to produce a plurality of articles that are mutually interconnected through bridges.

[0006] According to another embodiment of the invention wherein the laminating line is located separately from the moulding line in a clean room.

[0007] According to another alternative embodiment of the invention, the laminating line comprises a hot press station before the heating station.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0008] In the following detailed portion of the present description, the invention will be explained in more detail with reference to the exemplary embodiments shown in the drawings, in which

Figure 1 is a diagrammatical side view of the moulding line,

Figure 2 is a diagrammatical side view of the laminating line according to the invention,

Figure 3 is a layout of the production line according to the invention, and

Figure 4a and 4b are elevated views on a plurality of interconnected moulded pulp articles and on a disconnected moulded pulp article.

### DETAILED DESCRIPTION OF THE INVENTION

[0009] With reference to the figures 1 and 2, a production line for manufacture of moulded pulp articles 5 laminated by welding of plastic film sheets comprises a moulding line 1 and a laminating line 3.

[0010] The articles 5 are typically three dimensionally contoured moulded pulp packages such as food- or meat trays. These articles 5 have a relatively thin wall of fibre material such as paper pulp or wood pulp. The articles 5 are intended to be food trays and must therefore be laminated in a clean (hygienic) area.

[0011] As shown in figure 3, the laminating line 3 is located in a clean room separately from the moulding line 1. The two lines are separated. The laminating line 3 and the moulding line 1 are connected by a conveyor 10 that passes through an air lock into the clean room. The plastic film 4 must be suitable for thermo-forming, preferable gas impermeable or comprise a barrier against certain gases and moisture. Multilayer films 4 with an overall thickness of approximately 50µm provide sufficient thickness after laminating to comply with the barrier standards.

[0012] Figure 1 shows diagrammatically a suction moulding line 1 for moulding articles 5 from pulp material. The line starts with a moulding station 20. The

moulding station 20 comprises a mould carrier 21, on the outside of which are placed several liquid-permeable suction moulds 22 adapted to be connected with a source of subatmospheric and to a source of super-atmospheric pressure (not shown).

[0013] The mould carrier 21 is with a part of its circumferential surface immersed in a pulp vat 25 containing a fibre pulp suspension. This pulp may be made from a fibrecontaining raw material, such as waste paper or cardboard. During the immersion in the pulp mass, a layer of fibre material is deposited by suction on the mould surfaces of the suction mould 22. Subsequently, when the suction moulds 22 are withdrawn from the fibre suspension in the pulp vat 25, the suction is continued to compact the deposited fibres while exhausting residual liquid therefrom. After withdrawing the mould from the pulp vat 25, the mould will follow the rotary trajectory of the rotatable mould carrier 21 and thereby suck air through the articles 5 which are thereby partially dewatered, the moulds 2 are further rotated to the position where the articles 5 are blown off from the suction moulds 22 and aspirated onto transfer moulds on the transfer rotor 26. After a part of a revolution of the transfer rotor 26, the articles 5 are blown off therefrom onto a carrier system 27 which transports the articles 5 to a drying oven 28 for a drying procedure. In the drying oven 28, the articles 5 reach their final dry matter weight content of at least 90 weight per cent.

[0014] A group of articles 5 may be moulded in the form of a common continuous body with bridges interconnecting the articles 5, said bridges for the sake of simplicity being shown in the form of a common bridge sheet in the drawing (cf. Figure 4a). Instead of a common plate, the bridge connection may also be formed by ribs (cf. Figure 4b), and the bridge connection may also comprise a directly abutting connection between the mutually facing sides of two adjacent articles 5. The articles 5 are provided with lateral tabs or flanges 6 for engagement or gripping by transport means.

[0015] From the drying oven 28, a conveyor 10 transports the moulded pulp articles 5 through a humidification station 30 to the laminating line 3. The conveyor 10 comprises a buffer of articles 5 between the moulding line 1 and the laminating line 3 in order to avoid gaps in the supply of moulded pulp articles 5 to the laminating line 3. The operation speed of the laminating line 3 depends on the number of articles 5 in the buffer, i.e. less articles 5 in the buffer, the lower result in a low operation speed.

[0016] The articles 5 leaving the drying oven 28 are too dry for a hot press operation. Therefore, a controlled humidification takes place in the humidification station 30 to obtain a smooth surface of the product with exact dimensions after the hot pressing in the heated tools which create a steam pressure.

[0017] The laminating line 3 is arranged in a clean room 40 that is separated from the moulding line 1 and the humidification station 30 in order to avoid contami-

nation. In the clean room 40, an overpressure is maintained in order to avoid unclean air coming in. A wall 42 separating the clean room 40 from the moulding line environment is provided with an opening 43 with a tunnel 45 extending therefrom into the moulding line environment. The tunnel 45 increases the flow restriction for the air flowing out through the opening thereby reducing the amount of lost pressurised air.

[0018] The laminating line 3 comprises a hot press station 50, a heating station 69, a laminating station 80, a crystallisation station 90, a cutting station 93, a stacking station 99 and a conveying apparatus 56 which serves to guide and transport the moulded articles 5 and the plastic film 4 through the stations.

[0019] At the start of the laminating line 3, the moulded pulp articles 5 or the plurality of moulded pulp articles 5 are positioned in the hot press station 50 by means of two transversely spaced sets of actuators 52,53 receiving a closed loop control signal from two transversely spaced photo cells 54,55 in order to position the front edge of the article or plurality of articles 5 exactly perpendicular to transport direction.

[0020] The hot press 51 comprises an upper 57 and a lower 58 tool complementary shaped in accordance with the article 5 to be laminated. The upper tool 57 and the lower tool 58 both move towards the article 5 when the hot press 51 is closed. Both tools 57,58 are heated by conventional means. The hot press action heats the moulded pulp article 5 extremely fast to a temperature of about 50 to 100 degrees Celsius. When the hot press 51 is closed, the lateral tabs or flanges 6 on the articles 5 or plurality of interconnected articles 5 extend out of the tools 57,58 so that they can be engaged by the conveyor apparatus 56.

[0021] A conventional conveying apparatus 56 comprises two transversely spaced rails 59 extending along the longitudinal axis of the laminating line 3. The distance between the rails 59 can be adjusted in accordance with the width of the articles 5 or the width of the plurality of interconnected articles 5. Each rail 59 defines two channels, an upper and a lower channel in which a spiked chain is guided (not shown). In the upper channel, the spiked chain moves forward through the laminating line 3 while in the lower channel the spiked chain returns to the start of the laminating line 3. The upper channel also defines a surface for guiding the tabs or flanges 6 of the articles 5 and is provided with a groove in which the spikes partially extend. Thus, the spikes extend through the tabs or flanges 6 and positively engage the flanges or tabs 6. The spikes penetrate the tabs or flanges 6 when the article 5 or the plurality of interconnected articles 5 is positively fixed in the closed hot press 51. When the hot press 51 opens, the chain is driven to transport the articles 5 to the next station.

[0022] Alternatively clamps, belts or other fixating means (not shown) can substitute the spiked chain.

[0023] Directly after the hot press station 50, the plastic film 4 is fed from a film reel 47 into the rails 59 through

a slot in the guiding surface of the upper channels. The spikes of the chain also penetrate the plastic film 4 and the plastic film 4 and the articles 5 are moved in unison by the spiked chain to the heating station 69.

[0024] The heating station 69 comprises a heating element above 70 and one under 71 the moulded pulp articles 5 and the plastic film 4. The plastic film 4 only absorbs a part of the radiation from the upper heating element 70 and the rest can be absorbed by the moulded pulp articles 5. The plastic film 4 is heated to above the glass temperature and the moulded pulp articles 5 have a temperature less than 200 degrees Celsius when they leave the heating station 69.

[0025] The next station is a conventional laminating station which comprises an upper 81 and a lower table 82. The upper table 81 is provided with die press tool 83 whereas the lower table 82 is provided with a heated suction mould 84. Both the upper and lower table move towards the film 4 and the moulded pulp article 5. A partial vacuum is applied to the suction mould 84. The film 4 is bonded to the moulded pulp articles 5 by being drawn downwardly by the partial vacuum applied to the suction mould 84 through the moulded pulp article 5 and/or by the press tool 83. The upper table 81 may also be provided with means (not shown) to apply compressed air to the upper side of the plastic sheet 4.

[0026] Further, the laminating station 80 comprises a separately movable hot tool 85 for laminating the plastic film 4 to selected (flange) areas of the moulded pulp articles 5 in order to positively weld the film 4 to these areas of the moulded pulp articles 5.

[0027] The articles 5 with the film 4 laminated thereon are then transported by the conveyor 56 to the crystallisation station 90. This station comprises an upper heating element 91. By exposing the plastic film 4 to the heat, a crystallisation from amorphous to crystalline can take place if desired. In the case of food trays, this renders the laminated moulded pulp article 5 resistant to the heat of a domestic oven.

[0028] Next, a conventional cutting station 93 comprising an upper 94 and a lower movable tool 95 for die cutting separates the plurality of interconnected articles 5 and for removing superfluous flange material such as the tabs or flanges 6 for gripping by the conveyor 56. Either the upper or the lower tool is provided with a knife 96 to cut off the flange areas. The articles 5 remain connected to the "waste" material by narrow bridges in order to allow further transport to a stacking station 99.

[0029] After the cutting station 93, a conventional stacking station 99 stacks the laminated moulded pulp articles 5 so that they may be removed batch-wise from the laminating line 3.

[0030] According to a not shown embodiment, a filling and sealing line is arranged in line/ off line with the laminating line for filling the trays with food or other products and then sealing the filled tray with a plastic top sheet. Thus, the laminating line does not comprise a stacking station.

## LIST OF REFERENCE NUMERALS

### [0031]

5	1	moulding line
	3	laminating line
	4	plastic film
	5	article
	6	tab or flange
10	10	conveyor
	20	moulding station
	21	mould carrier
	22	suction mould
	25	pulp vat
15	26	transfer
	27	carrier system
	28	drying oven
	30	humidification station
	40	clean room
20	42	wall
	43	opening
	45	tunnel
	47	film reel
	50	hot press station
25	51	hot press
	52	actuator
	53	actuator
	54	photocell
	55	photocell
30	56	conveyor
	57	upper tool
	58	lower tool
	59	rail
	69	heating station
35	70	upper heating element
	71	lower heating element
	80	laminating station
	81	upper table
	82	lower table
40	83	press tool
	84	suction mould
	85	hot tool
	90	crystallisation station
	91	upper heating element
45	93	cutting station
	94	upper tool
	95	lower tool
	96	knife
50	99	stacking station

### Claims

1. Apparatus for producing articles (5) from moulded pulp material that are laminated with a plastic film (4) comprising a moulding line (1) and a laminating line (3), the moulding line (1) comprising a suction moulding station (20) with a pulp vat (25) and a

number of suction moulds (22), a drying oven (28) and conveying means (26,27) for transporting the moulded pulp articles (5) through the moulding line (1), the apparatus further comprises

conveying means (10) for transporting the moulded pulp articles (5) from the moulding line (1) to the laminating line (3) which is arranged in line with the moulding line (1), thus forming one continuous production line,  
the laminating line (3) comprising a plastic film supply unit (47), a heating station (69), a laminating station (80) and conveying means (56) for conveying the articles (5) through the laminating line (3).

2. Apparatus according to claim 1, wherein the moulding line (1) is adapted to produce a plurality of articles (5) that are mutually interconnected.
3. Apparatus according to claim 2, wherein the plurality of interconnected articles (5) are transported together through the moulding line (1) and the laminating line (3).
4. Apparatus according to any of claims 1 to 3, wherein the laminating line (3) is located separately from the moulding line (1) in a clean room (40).
5. Apparatus according to claim 4, **characterised in that** the conveying means (10) for transporting the moulded pulp articles (5) from the moulding line (1) to the laminating line (3) passes through an opening (43) in a wall (42) separating the laminating line (3) from the moulding line (1), whereby preferably a tunnel (45) is extending from the opening (43) towards the moulding line (1) in which tunnel the conveying means (10) is received.
6. Apparatus according to any of claims 1 to 5, wherein the laminating line (1) further comprises a hot press station (50) and a corresponding humidification station (30) before the heating station (69).
7. Apparatus according to any of claims 1 to 6, wherein the conveying means (10) for transporting the moulded pulp articles (5) from the moulding line (1) to the laminating line (3) comprises a buffer of moulded pulp articles (5).
8. Apparatus according to any of claims 1 to 7, further comprising a means (52,53,54,55) for positioning the moulded pulp articles (5) with respect to the hot press station (50).
9. Apparatus according to claim 8, wherein the moulded pulp articles (5) are fixed with respect to the conveying means (56) for transporting the articles (5)

through the laminating line (3) when the hot press (51) is closed.

10. Apparatus according to any of claims 1 to 9, wherein the laminating station (3) further comprises a hot tool (85) for laminating the plastic film (4) to selected areas of the moulded pulp articles (5) in order to weld the film (4) in these areas to the moulded pulp articles (5).
11. Apparatus according to any of claims 1 to 10, wherein the laminating station (3) comprises means for applying underpressure to the film (4) through the moulded pulp articles (5) and/or a pressing tool (83) and/or means for applying overpressure to the film (4) in order to shape the plastic film (4) and press it onto the moulded pulp articles (5) and secure sufficient bonding of the film (4) to the articles (5).
12. Apparatus according to any of claims 1 to 11, wherein the moulded pulp articles (5) or a plurality of interconnected moulded pulp articles (5) are moulded with laterally protruding tabs or flanges (6) which are gripped or engaged by the conveying means.
13. Apparatus according to claim 12, wherein the conveying means (56) for transporting the articles (5) through the laminating line (3) engage both the tabs or flanges (6) of moulded articles (5) or of the plurality of interconnected moulded pulp articles (5) and the plastic film (4) sheet with a common engagement means.
14. Apparatus according to any of claims 7 to 13 in which the operation speed of the laminating line (3) depends on the number of moulded pulp articles (5) in the buffer.
15. Apparatus according to any of claims 1 to 14, further comprising a film crystallisation station (90) after the laminating station (80).
16. Method of producing moulded pulp articles (5) with a plastic film (4) laminated thereon comprising the steps of,  
providing a pulp vat (25),  
providing at least one suction mould (22),  
submerging at least one suction mould (22) in the pulp vat (25),  
removing the moulded pulp articles (5) from the suction mould (22) and conveying the moulded pulp articles (5) through a drying oven (28) to dry them,  
transporting the moulded pulp articles (5) in line from the drying oven (28) to a laminating line (3),

supplying plastic film (4) to the laminating line  
(3),  
heating the plastic film (4) and the moulded pulp  
articles (5),  
laminating the film (4) onto the moulded article 5  
(5) and crystallising the plastic film (4).

17. Method according to claim 16, wherein a plurality of  
articles (5) mutually interconnected through bridges 10  
are moulded together as an integral body which is  
conveyed as one entity through the moulding line  
(1) and the laminating line (3).

18. Method according to claim 17, wherein the moulded  
pulp articles (5) or a plurality of interconnected 15  
moulded pulp articles (5) are moulded with laterally  
protruding tabs or flanges (6) which are gripped or  
engaged by the conveying means (10).

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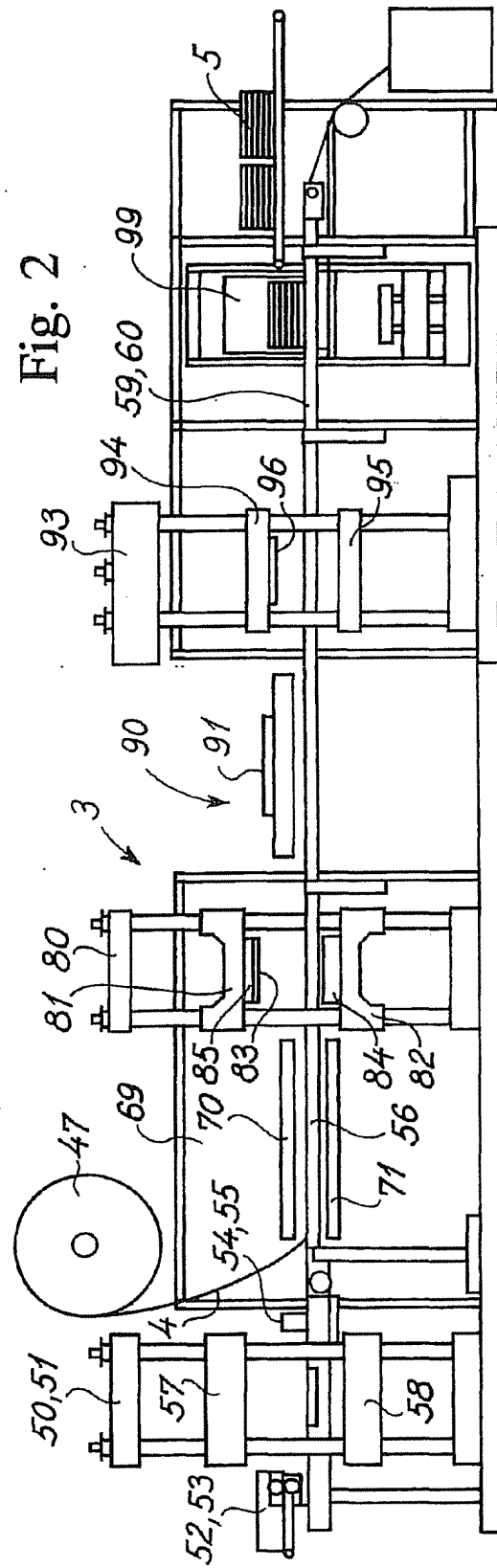
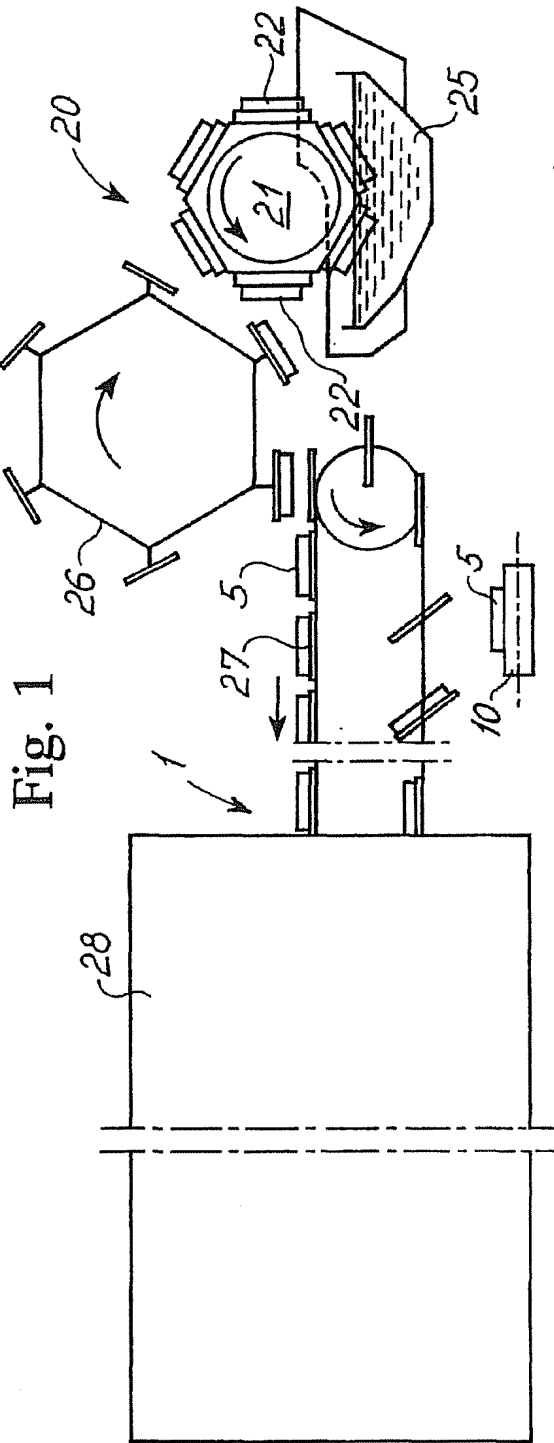
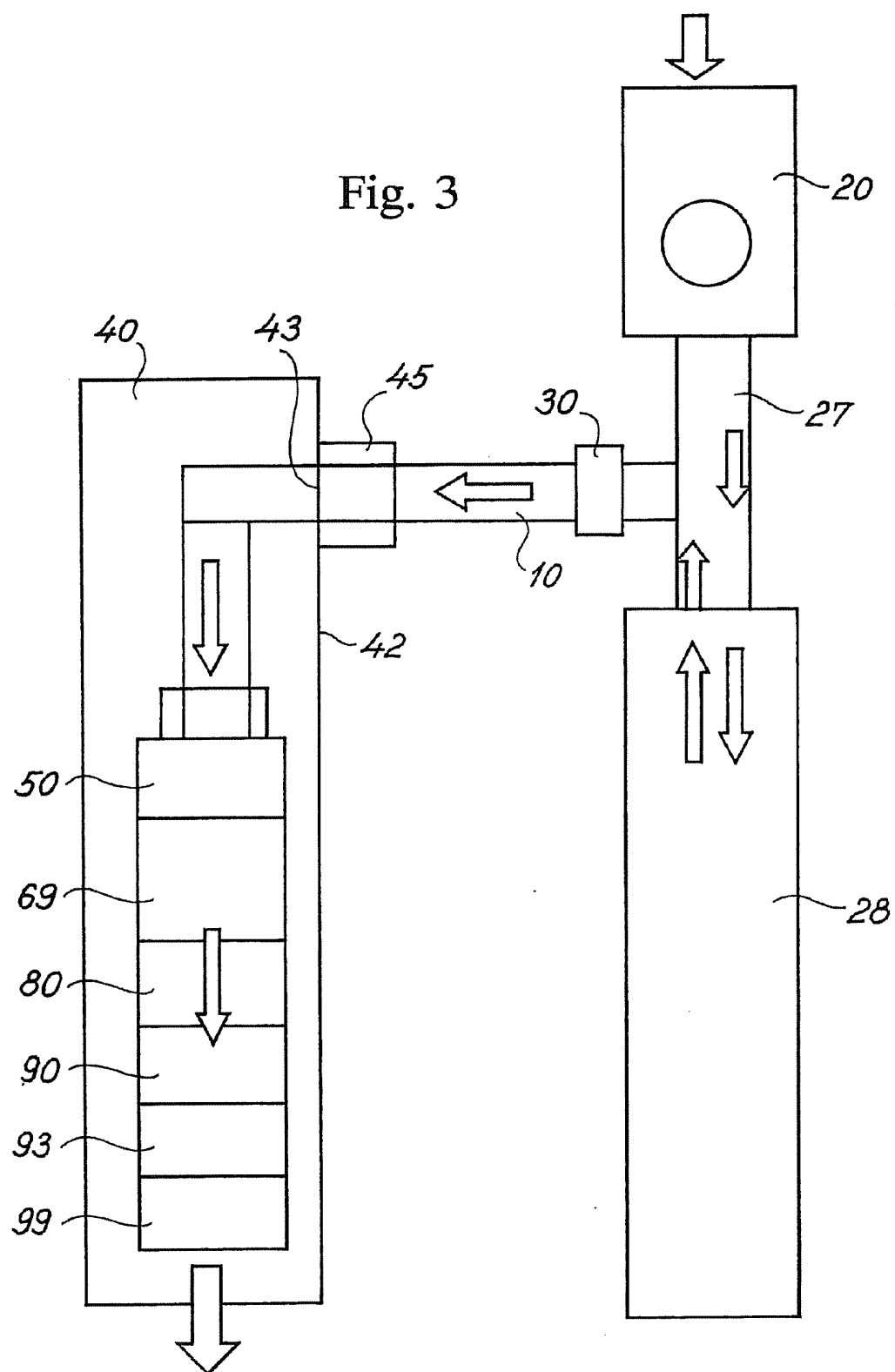




Fig. 3



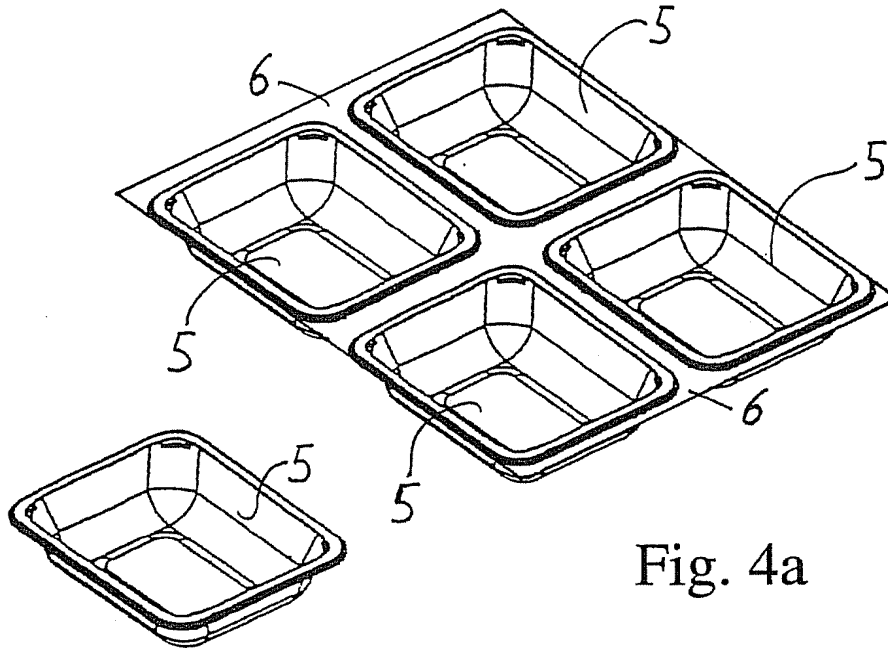


Fig. 4a

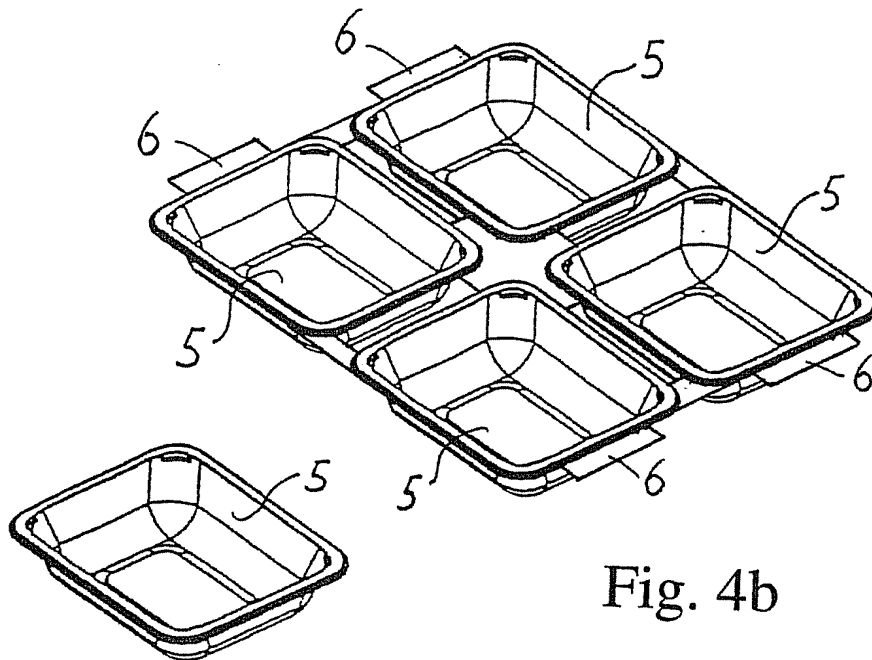


Fig. 4b



European Patent  
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# EUROPEAN SEARCH REPORT

Application Number  
EP 00 10 7270

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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>24 August 2000</b>	Examiner <b>Kosicki, T</b>
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>T : theory or principle underlying the invention  E : earlier patent document, but published on, or after the filing date  D : document cited in the application  L : document cited for other reasons  &amp; : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 00 10 7270

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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